formance) or by generating alertness/sleepiness predictions (which, as noted above, do not always correspond to cognitive performance). The invention can be "exercised" in hypothetical sleep/wake and duty scenarios to provide an estimate of cognitive performance under such scenarios. To the extent that optimizing cognitive performance is of interest to the general public, there is a possibility for use in a variety of applications.

This invention also may be used in conjunction with drugs to alter the sleep/wake cycle of an individual and/or optimize or minimize the cognitive performance level of an individual as needed and/or desired.

This invention also can work conjunctionally with the concepts of particle swarm theory/algorithms. Particle swarm algorithms are routinely used to optimize the throughput of containers through a ship port or to optimize the use of workers within a work group to perform tasks over a given period. An example of an application is the planning of a mission for an army unit by its commander.

The method may also be used to gauge and evaluate the cognitive performance effects of any biomedical, psychological, or other (e.g., sleep hygiene, light therapy, etc.) treatments or interventions shown to improve sleep. Examples of these include but are not limited to patients with overt sleep disorders, circadian rhythm disorders, other medical conditions impacting sleep quality and/or duration, poor sleep hygiene, jet lag, or any other sleep/wake problem. Currently, the efficacy of treatments for improving sleep is determined by comparing baseline polysomnographic measures of nighttime sleep and some measure of daytime alertness (e.g., the MSLT, the Maintenance of Wakefulness Test (MWT), the Stanford Sleepiness Scale or the Karolinska Sleepiness Scale) with the same measures obtained after treatment. Both treatment efficacy and the likely impact on performance during waking periods are inferred from the results on the daytime alertness tests. For example, the Federal Aviation Administration currently requires any commercial pilots diagnosed with sleep apnea to undergo treatment. Such treatment is followed by daytime alertness testing on a modified version of the MWT. During the MWT, pilots are put in a comfortable chair in a darkened room and instructed to try to remain awake for extended periods. If the pilots are able to avoid overt sleep under these sleep-conducive conditions then they are deemed fit for duty. The inference is that the minimal ability to maintain wakefulness at a discrete point in time translates into the ability to operate an aircraft safely (i.e., it is inferred that alertness is equivalent to cognitive performance). However, sleep deprivation can affect cognitive performance even when it does not result in overt sleep, particularly during an alertness test when for various reasons the individual may be highly motivated to stay awake.

In contrast, the current method allows cognitive performance to be estimated directly from measured sleep parameters considered in conjunction with the time of day and performance of tasks. The advantages of this method over current methods for evaluating treatment efficacy are: (1) the motivations and motivation levels of the patients being tested cannot affect results (cognitive performance determinations); and (2) the method allows numerical specification and prediction of cognitive performance across all projected waking hours rather than indicating alertness at a discrete, specified point in time. Thus, the method provides a continuous scale for gauging cognitive performance across time rather than providing only a minimal "fitness for duty" determination based on the patient's ability to maintain EEG-defined wakefulness at a specific time.

The method may also be used clinically as an adjunct for diagnosing sleep disorders such as narcolepsy and idiopathic CNS hypersomnolence. Equally important, it may also be used to differentiate among sleep disorders. The latter is critical to the course of treatment, and consequent treatment efficacy depends on a valid and reliable diagnosis. For example, sleep apnea and periodic limb movements during sleep are characterized by nighttime sleep disruption (i.e., partial sleep deprivation) accompanied by daytime cognitive performance deficits. In contrast, narcolepsy and idiopathic hypersomnolence tend to be characterized by apparently normal nighttime sleep, but accompanied by daytime cognitive performance deficits. Based on the apparently normal nighttime sleep in the latter two groups, the invention would predict relatively normal cognitive performance. Thus, a discrepancy between predicted cognitive performance (based on the current invention) and observed or measured cognitive performance could be used to distinguish one sleep disorder from another. For example, narcolepsy, idiopathic hypersomnolence, or other CNS-related causes of daytime cognitive performance deficits (where no sleep deficit is apparent) could be distinguished from sleep apnea, periodic limb movements, or other causes of daytime cognitive deficits (where impaired sleep is evident).

Although the present invention has been described in terms of particular preferred embodiments, it is not limited to those embodiments. Alternative embodiments, examples, and modifications which would still be encompassed by the invention may be made by those skilled in the art, particularly in light of the foregoing teachings.

Furthermore, those skilled in the art will appreciate that various adaptations and modifications of the above-described preferred embodiments can be configured without departing from the scope and spirit of the invention. Therefore, it is to be understood that, within the scope of the appended claims, the invention may be practiced other than as specifically described herein.

We claim:

1. A method comprising:

modeling a circadian rhythm having a first sinusoidal curve with a 24 hour period and a second sinusoidal curve with a 12 hour period using a processor,

calculating a cognitive level of a person using a processor based on the person's sleep/wake data received from an actigraph or a polysomnography system,

calculating a predicted cognitive performance based on said circadian rhythm and said cognitive level using a processor.

2. The method according to claim **1**, wherein said sleep/wake data contains a series of epochs where each epoch is classified as sleep or wake.

3. A system comprising:

at least one input device for receiving sleep/wake data,

a microprocessor including

means for modeling a circadian rhythm,

means for determining a cognitive level of a person based on the person's sleep/wake data at predetermined fixed intervals having an identical time period, wherein there are multiple intervals in each 24 hour period and

means for calculating a predicted cognitive performance in response to said determination of said cognitive level based on said circadian rhythm and said cognitive level, and

a display to show the predicted cognitive performance.

4. The system according to claim **3**, wherein said input device is in communication with an actigraph.